

Improving Electron Thermodynamics in GRMHD Simulations of Black Hole Accretion

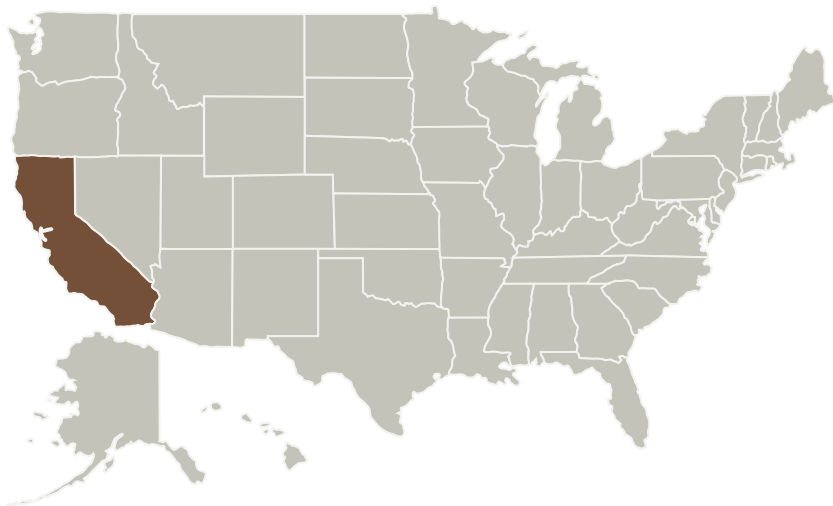
Completed Technology Project (2016 - 2017)



Project Introduction

The goal of this project remains to improve the electron thermodynamic calculations in General Relativistic Magnetohydrodynamics (GRMHD) simulations of low accretion rate systems to allow for more predictive modeling of astrophysical systems. We have successfully implemented a model in 3D GRMHD simulations that separately evolves an electron entropy equation, including the effects of electron heating and anisotropic electron thermal conduction along magnetic field lines. I am in the later stages of using these simulations to compare to observations of the supermassive black hole at the galactic center, Sagittarius A*, and have found that our model can naturally produce most features of the spectral energy distribution with only a limited number of free parameters. In collaboration with Ben Ryan of UIUC, I am improving this model to include the effects of radiative cooling, scattering, and absorption on both the electrons and total fluid. This for the first time allows for self-consistent comparison of simulations to observations of systems with higher accretion rates than Sgr A* where radiative cooling is more efficient. Future work will apply this scheme to observations of the supermassive black hole in M87 and certain X-ray binary systems. Additional future work will focus on adding the effects of electron-ion Coulomb collisions on the electron entropy equation and improving the semi-analytic calculations of our closure model for electron heating.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

Astrophysics

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Organizations Performing Work	Role	Type	Location
Regents of the University of California	Supporting Organization	Academia	Oakland, California

Primary U.S. Work Locations

California

Project Management

Program Manager:

Joe Hill-kittle

Principal Investigator:

Eliot Quataert

Co-Investigators:

Sean M Ressler
David M Weldon

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
 - └ TX09.4 Vehicle Systems
 - └ TX09.4.5 Modeling and Simulation for EDL

Target Destination

Outside the Solar System